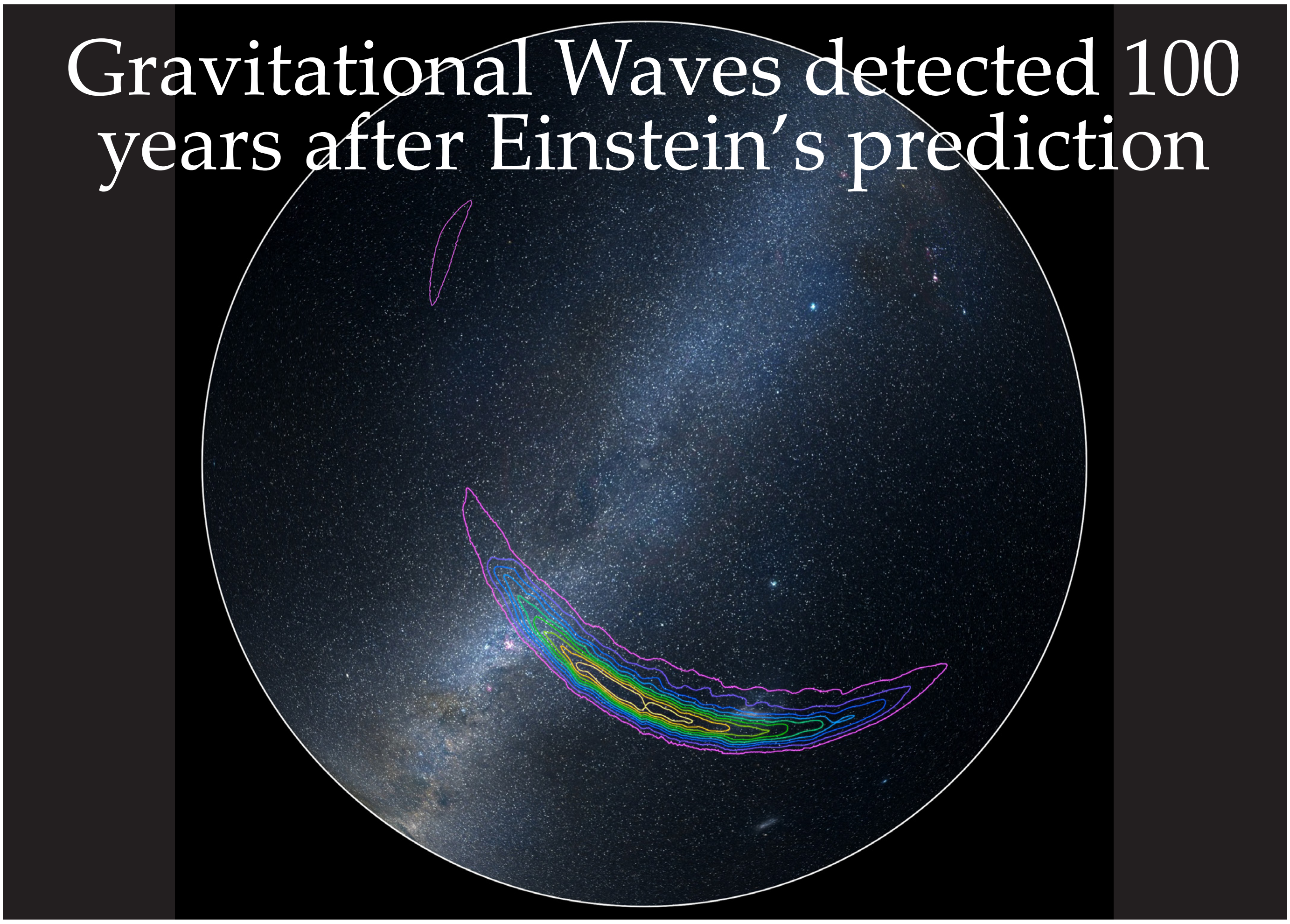
Vol.8 | Issue 1 | April 2016 SAIP Webpage

Physics Comment

A Southern African Physics Magazine



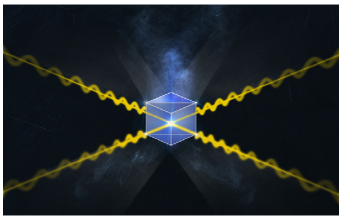
A Quarterly Newsletter Vol.8 | Issue 1 | April 2016

South African Schools liasing with CERN

Teacher from Johannesburg school takes part in CERN programme (pg 4)

New Experimental power at Bloemfontein

University of the Free State installs tuneable laser based fluorescence spectrometer {pg 22)



Interference of entangled light

Researchers from Wits, the NLC and UKZN and Scotland are the first to see interference of photons entangled in two degrees of freedom (pg 20)

Clock turned back to 10 minutes to 12 for the nuclear deal

The controversial purchase of eight nuclear reactors is debated. What is your opinion? (pg 10)

Contents

Editor's Note

As pointed out in a press conference that announced the first detection of gravitational waves (https://www.ligo.caltech.edu/video/ligo20160211v11): general relativity has never been tested before in the highly nonlinear regime of strong gravitational fields and fast moving bodies. And out came a powerful confirmation of Einstein's theory. The variation of distancies caused by the gravitational wave were measured with the most accurate rulers constructed so far: two Michelson interferometers each with a spatial resolution of an attometer (10^{-18} m).
Albert Einstein had asked for three experimental tests before he himself would accept the validity of general relativity - one was the detection of gravitational waves. However, he said they would be too weak to ever be detectable. He was only wrong in this - as it has now turned out (pg 17).

In this issue of *Physics Comment* we also report on advances in South African labs, for example at Wits (pg 6 and pg 20) and Bloemfontein (pg 22). I wish you an interesting read.

With best wishes
Prof Thomas Konrad

Image on front page: Where the Gravitational Waves Came From. *The approximate location of the source of gravitational waves detected on September 14, 2015, by the twin LIGO facilities is shown on this sky map of the southern hemisphere. The colored lines represent different probabilities for where the signal originated: the purple line defines the region where the signal is predicted to have come from with a 90 percent confidence level; the inner yellow line defines the target region at a 10 percent confidence level. The gravitational waves were produced by a pair of merging black holes located 1.3 billion light-years away. A small galaxy near our own, called the Large Magellanic Cloud, can be seen as a fuzzy blob underneath the marked area, while an even smaller galaxy, called the Small Magellanic Cloud, is below it. Researchers were able to home in on the location of the gravitational-wave source using data from the LIGO observatories in Livingston, Louisiana, and Hanford, Washington. The gravitational waves arrived at Livingston 7 milliseconds before arriving at Hanford. This time delay revealed a particular slice of sky, or ring, from which the signal must have arisen. Further analysis of the varying signal strength at both detectors ruled out portions of the ring, leaving the remaining patch shown on this map. In the future, when additional gravitational-wave detectors are up and running, scientists will be able to pinpoint more precisely the locations and sources of signals. Image Credit: LIGO/Axel Mellinger.*

Physics Comment is a journal published by the South African Institute of Physics (SAIP) and appears quarterly . The vision of the SAIP is to be the voice of Physics in South Africa.

News from Africa

Lizelle Swanepoel, inside the LHC underground tunnel (CMS collider site) at CERN,

SAHETI School collaborates with CERN

By Lizelle Swanepoel, Saheti School, Bedfordshire, Johannesburg

Lizelle Swanepoel, head of Science at SAHETI School, has recently returned from CERN (The European Organization for Nuclear Research) in Switzerland. Founded in 1954, the CERN laboratory sits on the Swiss-French border near Geneva and is the birthplace of the World Wide Web, the touch screen, PET imaging sensors, the Large Hadron Collider (LHC) as the largest single machine ever built (100 m underground) and antimatter. CERN does research on the fundamental particles of matter by colliding protons at a speed close to the speed of light. The following is her account of the trip.

An exclusive invitation

I visited CERN to attend a 3-week residential programme and get a taste of frontier research in modern physics. Participants in the programme were selected from 32 countries across the world. I was one of 50 teachers who took part from 4-25 July 2015 and the only teacher from the African continent. CERN HST is a teachers programme aimed to bring modern physics into the classroom, with focus on the fields of particle physics, cosmology, astrophysics and engineering. This is open to all high school Science teachers from all CERN member states and non-member states, subject to funding. I am grateful to SAHETI and the University of Cape Town for funding a large part of this scintillating experience.

> CERN teachers programme to bring modern physics to the classroom

Innovation and collaboration at CERN

The grand scale of innovation going on at CERN is impressive. After its famous discovery of the Higgs boson in 2012, the second run of experiments started this year. Since then they have discovered another new particle called the pentaquark. I feel privileged to have been at CERN during that time, and receiving a lecture on the pentaquark just days after its discovery.

The two large LHC experiments at CERN are ATLAS and CMS, who work separately but in collaboration. ATLAS was the first to confirm their discovery of the Higgs boson. There are many other cool experiments going on at CERN, of which ISOLDE (the radioactive ion beam facility), , AMS (analysing data from NASA's international space station to look for dark matter, antimatter and missing matter), ALICE (another LHC experiment) and the AD (antimatter factory) are but some.

Discovery in the air

The feeling of collaboration and discovery is tangible at CERN, with scientists from all over the world working together. It has been a hub of activity while I was there, with so many post-doc summer students from across the world doing experiments. Young and old all contribute to Physics at CERN. It is not uncommon to see really old people shuffling through the corridors, who still make an active contribution to high energy physics. Nobel laureates can also be spotted all over CERN! It is truly the most inspiring place on earth from a scientific point of view.

Lectures, visits, discussions, hands-on workshops, workgroup projects and social events

Our programme consisted of 3 hours of lectures in particle physics, cosmology and astrophysics daily, visits to facilities, workshops, hands-on labs and time spent on chosen projects for presentation at the end of the course. Projects ranged from detection of cosmic rays such as muons, LHC data analysis, medical applications of CERN technologies, the importance of girls and women in Physics, educational games, comparing science curricula from across the globe and building an MX-10 pixel detector, a Paul trap and a prototype of the ATLAS detector. My workgroup and I had hours of fun building a working prototype of the ATLAS detector's magnetic system. We had Q & A sessions with experiment leaders and 2015 director general Prof Rolf Heuer, where we discussed the future of CERN and education, CERN in the media and how to educate the public about science. I've had the privilege of meeting Prof Fabiola Gianotti, who has taken over the reigns as new director general of CERN in 2016 and who is the first woman ever to head CERN. What an inspiration she is!

The role of teachers and responsibility to CERN

CERN HST inspires teachers to raise and maintain the interest of students in science and specifically modern physics. CERN recognises the teacher's ability to instil a feeling of mystery and discovery potential in their students, which can motivate them to study science and engineering at university. I feel privileged to have attended a course at CERN and eagerly promote what they do at this extraordinary place by sharing it with pupils and teachers alike. This programme is the ideal platform for equipping teachers to inspire and prepare our future scientists and engineers.

Connections & collaboration

I will cherish my experience at CERN for a lifetime and will continue to share it in years to come. I hope to take a group of students to CERN in the near future. Connections made with like-minded teachers from so many different countries have been most valuable. We have become ambassadors for CERN and would like to expose our students to the spirit of collaboration and internationalism felt there. I hope to foster more of these qualities in our students. Thank you, CERN HST! ■

Physics Bowl: Fun at SAIP2016

The Physics Bowl is a competition for student teams which started at UCT. Last year it swept through the Western Cape. This year it goes national at SAIP2016. Form your teams and join in!
http://www.saip.org.za/…/doc…/Physics_Bowl_2016_Pamphlet.pdf

Update on Proceedings of SAIP2015

Makaiko Chithambo (Rhodes University, Grahamstown) and André Venter (NMNU, Port Elisabeth), Guest Editors for the Proceedings the SAIP2015 Conference

Work on publishing the proceedings of SAIP2015 Conference has moved slower than we would have liked. In order to improve the scientific quality and ensure the credibility of the proceedings, it essential that manuscripts be evaluated by competent individuals. The physics community in South Africa is small and the onerous responsibility of reviewing manuscripts cannot be left to a few individuals. This may seem obvious but to our disappointment we have found that many are unwilling to review papers for the proceedings. What is even more ironic is that quite a few of the unresponsive reviewers or their students did in fact submit papers to be reviewed for the proceedings.

We would like to thank the many other physicists who have selflessly assisted with the evaluation of papers.

We reassure all authors that we are working tirelessly to have the proceedings published on time. ■

Structured Light Laboratory launched at Wits

By Prof Andrew Forbes, Wits, Johannesburg

Prof Forbes and his group in the laboratory for structured light.

People from business and industry were treated to the fascinating work undertaken at the Structured Light Laboratory at Wits University which was launched on 4 March 2016.

Professor Andrew Forbes, a Distinguished Professor and Head of the laboratory together with the 15-member team explained the purpose of the laboratory and some of the latest research that is being conducted to over 50 interested stakeholders.

The laboratory, which started off has an empty room with old wooden tables, now offers equipment and space to carry out work at both the classical and quantum levels and includes topics that range from purely theoretical to purely experimental.

During his presentation, he said he has a strong team that comprises post graduate students, post-doctoral fellows and visiting academics.

Forbes spoke about photonics, one of the fastest growing technology fields. He said South Africa doesn't have an electronics or photonics industry to speak of but small groups are starting to make a dent in this field and branching out into new technology.

"We can structure light and tailor and customize it to be almost anything that we want." Structured Light relates to the creation of arbitrarily complex light patterns, for example, accelerating light, non-diffracting light, vector light fields and light carrying optical vortices and orbital angular momentum.

Forbes explained on their website that they create these fields by a range of techniques, but primarily using digital holograms written to spatial light modulators.

"We then apply Structured Light in applications such as optical trapping and tweezing of single cells, increased

> "We can structure light and tailor and customize it to be almost anything that we want."

optical bandwidth in free space and fibre optical communication systems using spatial modes of light, and increased security in quantum links. In many cases our detection schemes are also digital holograms – it is our aim to demonstrate the all-digital control of light," Forbes explained.

Our research builds competency in mathematical algorithms applied in optics, both theoretically and computationally, non-linear optics, diffractive optical elements, micro optics, adaptive optics, refractive beam shapers, digital holograms, spatial light modulators and wavefront sensing.

In 2015, which was declared the Year of Light by UNESCO, Forbes and his team produced 17 journal papers, won seven prizes and produced four popular articles. Team members attended 13 international conference proceedings and Forbes delivered 14 invited talks to speak at various events around the globe. This team's work also generated significant media interest, featuring in at least 20 news stories. This unit has numerous national and international collaborators and several industry partners.

There are four notable achievements thus far in 2016: the creation of a vector microchip laser; the first demonstration of quantum interference in high dimensions; a new approach to packing information into light, which the group sent over free space (air) and optical fibre (glass), as well as bringing this cutting edge science back into teaching through the use of digital holograms to demonstrate some very basic physics and mathematics in a laboratory.

Forbes said there are more projects in the pipeline for this year.

Professor Zeblon Vilakazi, DVC: Research & Postgraduate Affairs said for those people that follow global trends, the fourth revolution, based on light and photonics is about to unleashed. He added that the only way for South Africa to not miss out on this revolution is to invest in this science. Vilakazi said that he feels there will be lots of investment in physics partially because it responds to some of our global challenges.

Main projects presently include:

- Classical entanglement with vector vortex beams;
- Quantum imaging;
- Secure quantum communication with high-dimensional entangled states;
- Propagation of spatial modes in free space and fibres for high bandwidth communication;
- Optical imaging and control of nanostructures; and
- Novel lasers using both the dynamic and geometric phase of light.

The International Virtual Observatory Alliance (IVOA) Meets in South Africa

Patricia Whitelock (SAAO, UCT), Lindsay Magnus (SA SKA) and Russ Taylor (UCT, UWC)

The Virtual Observatory Concept and the International Virtual Observatory Alliance

The Virtual Observatory (VO) is an international astronomical community-based initiative. It aims to enable global electronic access to astronomical data archives from space and ground-based observatories. It is a collection of tools for accessing and visualizing multi-wavelength data that collectively provide a scientific environment, rather than a physical observatory. A vast array of astronomical data-sets are already available at all wavelengths and many more are on the way. Amongst the largest will be the SKA at radio wavelengths and the Large Scale Synoptic Survey Telescope (LSST) at optical wavelengths. These very large databases will be archived and, through the VO, made accessible in a systematic and uniform manner to realise the full potential of the existing and future observing facilities.

> This will be the first IVOA Interop meeting to take place on the African Continent

The VO enables astronomers to work just as well in a small rural university, or even at home, as in an international observatory or large research university – provided they have access to the Internet and a very good scientific education. It also adds value to expensive infrastructure by allowing data to be used and reused many times.

The International Virtual Observatory Alliance (IVOA www.ivoa.net) is an organisation that debates and agrees to the technical standards that are needed to make the VO possible. It also acts as a focus for VO aspirations, a framework for discussing and sharing VO ideas and technology, and as a body for promoting and publicising the VO.

South African Involvement in the VO and IVOA

The South African Astroinformatics Alliance (SA^3) is the South African VO project (www.sa3.ac.za) and it has been part of IVOA since 2013. This is a collaboration of SAAO, HartRAO, the SA SKA project and IDIA (a multi-university data intensive astronomy partnership). SA^3 has three primary purposes:

- to facilitate access by the South African astronomical community to multi-wavelength astronomical data as well as to tools for dealing with them;
- to ensure that data produced by facilities in South Africa are accessible to the international community (in a manner that does not violate any ownership rights); to develop human capital through schools and workshops that introduce people to data and tools of the virtual observatory.

SA3 will host an IVOA Interoperability Meeting in South Africa in May 2016

The IVOA "Interop" Meetings provide a semi-annual venue for discussion and development of virtual observatory standards and VO-based applications, and are open to those with an interest in utilizing the VO infrastructure and tools in support of observatory operations and/or astronomical research. They also provide a formal opportunity for face-to-face meetings of the IVOA Executive and the various working groups.

Venue: Stellenbosch Institute of Advanced Study (STIAS). Date: 9 to 13 May 2013. Details: http://ivoa2016.sa3.ac.za/

News From Africa

This will be the first IVOA Interop meeting to take place on the African Continent and presents an exciting opportunity to showcase developments surrounding astronomy in this country.

Among the special activities planed are an extended plenary session dealing with the interoperability requirements of the major international astronomy projects, across all wavelengths. This will include presentations related to the Large Synoptic Survey Telescope (LSST), the Thirty Meter Telescope (TMT) and the Giant Magellan Telescope (GMT) for optical/infrared astronomy and the Low-Frequency Array for Radio Astronomy (LOFAR), the Australian Square Kilometre Array Pathfinder (ASKAP) and the Karoo Array Telescope (MeerKAT) for radio astronomy. Gamma-ray and space projects will also be represented.

Kevin Govender (IAU OAD) will be plenary speaker for a special session on the role of the VO in development, including its potential for teaching data-handling skills within physics and mathematics departments.

The main meeting will be focused and is intended for data science specialists and astronomers who are working on interoperability and the visualization of astronomical data, knowledge discovery and other issues associated with data curation and the handling of Big Data. Much of the discussion will be technical and unsuitable for non-specialists.

If you wish to make a contribution, then you should approach the chair of the Working Group or Interest Group in which you would like to present (see http://wiki.ivoa.net/twiki/bin/view/IVOA/InterOpMay2016). South African scientists who would like to participate should register on the web page (http://ivoa2016.sa3.ac.za/registration), preferably before 1 April. It is possible to attend for as little as one day, but you must pay for lunch on any day that you attend (regard this as a highly subsidised registration fee).

We have applied for NRF funds to support a small number of appropriately qualified specialists, particularly from outside of the Western Cape to attend this meeting, but will only know in April if the funding has been granted. If you are interested in such support please send an email to paw@saao.ac.za with the following information (before 1 April 2016):

- *Your full name and title;*
- *Your affiliation;*
- *If you are a student give the details of the course for which you are registered;*
- *Your reason for wanting to attend;*
- *Your possible contribution to the meeting.*

Please indicate what level of finance you would need to secure your attendance, and particularly note any contribution from your own institution.

Like the SAIP Facebook Page

Like the SAIP Face book page to stay in touch with latest news, events and job opportunities within the South African & International Physics Communities.If you have interesting physics related activities, events and opportunities you want posted please let us know and share those great moments with the community. https://www.facebook.com/South-African-Institute-of-Physics-1660099704207118/

SAIP at SciFEST Africa 2016

By Ndanga Mahani – Projects Officer SAIP

Description of the Event

Scifest Africa, South Africa's National Science Festival is a project of the Grahamstown Foundation supported by DST. It is an annual event established in 1996 to promote the public awareness, understanding and appreciation of science, technology, engineering, mathematics and innovation.

Scifest identifies and designs unique interactive events, and educational resources with scientific integrity to advance science, facilitate learning in an informal and non-threatening way, and provide learners a great opportunity to discover science outside the classroom.

Role at Event

Our role was to address the learners, teachers, undergraduates and the general public about SAIP membership and its activities. We were marketing and improving public understanding of physics thus increasing the impact, visibility, awareness and footprint of SAIP. We also did demos on electrolyte and plasma globe.

Scifest identifies and designs unique interactive events, and educational resources with scientific integrity to advance science

We handed out booklets on careers in physics, SAIP pamphlets, science cartoon pamphlets and SAIP branded materials. The opportunity also allowed us to provide career guidance and network with other organisations having the same vision as us.

Comments and Feedback

The learners ranged from primary level to grade 12. They were eager to learn about the plasma globe. The undergraduates were excited to know about the existence of SAIP and our conferences. The teachers from Umtata District expressed the need for the Teacher Development Programme model at their proximity. Most of Grade 8 and 9 learners showed interest in taking Physical Science and pure Maths as a subjects.

Statistics

We are still waiting for official statistics. We came back with more than 200 E-members ranging from primary learners, high school learners,educators to undergraduates.

Letters to the Editor

PC received two letters to the editor concerning the subject of reviewing in light of the upcoming annual SAIP conference.

The Reviewers Dilemma

Igle Gledhill, CSIR, Pretoria

Reviewing is a task that requires time and care, but is often a task that comes at low priority in the white-water world of universities and institutes. It goes unrecognised and is not acknowledged; reviewers are unknown to authors – thank goodness.

Most reviewers exercise integrity, apply their minds, and deliver on time. Many work through piles of papers and patiently advise and double-check. Sometimes they reach enlightenment by wading through swamps of poor phrasing and disconnected islands of logic. These I would call competent reviewers. These individuals deserve red carpets at every function and their names to be inscribed in rolls of honour. (I note that a roll of honour may be defined as a list of those whose deeds have been honoured or who have died in battle.)

The other reviewers are reviled by authors and editors for their interminable delays. Editors tear out their hair, if they have any left, as they take the well-known steps of reminding their crew of deadlines in encouraging automatic emails, and then in sharp personal notes, and then in thinly concealed rage. The departmental secretary is telephoned, and replies that the reviewer has gone to Australia, is on sabbatical, or is deceased.

The editor begins the search for a new reviewer who is in the field but not compromised by conflict of interest. The new reviewer is invited. In the most successful case, the new reviewer has usually just finished the reports on twenty papers, in which case a web of personal obligation is built. In the usual case, all possible new reviewers are in Antarctica or Hawaii, and cannot be contacted. And so the cycle begins again.

In South Africa, we have a wonderful situation: there is a vigorous, lively, productive student population. It does mean that there is a relatively small fraction of physicists qualified by their PhD to review, and therefore that those individuals must review more papers than they publish.

What do I get from reviewing? I learn – I learn much more than I would like to, in some cases. I contribute to the necessary work of a thriving community – at one end of the spectrum it's like doing the insurance and taking out the trash, and at the other it's satisfaction in a challenging job done well. Without this job, publications cannot happen. What we get from sound review is even more valuable than what I get from reviewing.

Which kind of reviewer will you be for SAIP2016, a competent reviewer or one of the other reviewers? ■

The reviewer

Makaiko Chithambo, Rhodes University, Grahamstown

Look, Mr Editor, I am busy

And who does this author think he is anyway

Submitting an idea and claiming it is superior to ours?

I can't find any evidence about his claim

This manuscript is far too long and goes into unnecessary detail

The data in Table 1 is contradictory

By the way the subject is also stale

Why study this sample when he could study one of my choice?

Mr Author, the reviewers have looked at your manuscript

They find nothing interesting in it

And your claims are unsubstantiated

I am afraid, I have to reject it

This decision is final and no correspondence can be entered into

Wait, I never claimed…?

I,…

As I said Sir, my decision is not subject to review

The matter is closed. ■

Physics and Society

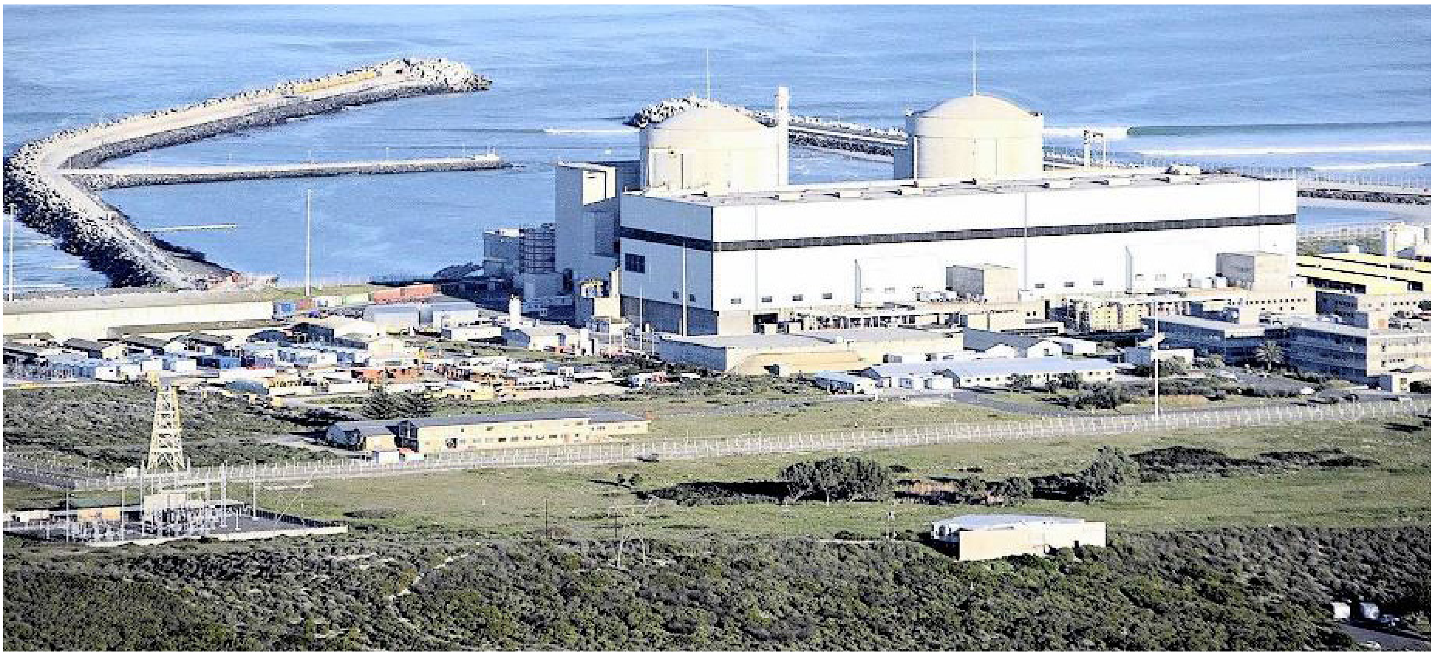
Editorial Note: The last issues of Physics Comment carried a discussion of the governmental plans to purchase nuclear reactors producing a total of 9 Gigawatt of electrical power for approximately one Trillion Rand. In the last issue of PC two articles described the pros and cons of the "nuclear deal", One of them was written by the former CEO of the lobbying association Nuclear, Dr Kelvin Kemm, who has now became the chairperson of the South African Nuclear Energy Cooperation NECSA.

The nuclear deal

Hartmut Winkler, Department of Physics, University of Johannesburg, Johannesburg.

Dear Editor

I need to weigh in on the nuclear power debate between Dr Kemm and three UKZN physicists published in the December 2015 edition of "Physics Comment". Disregarding Dr Kemm's unfortunate insensitive remarks that "no people were killed or injured by nuclear radiation" (which of course tends to happen years, even decades, after exposure), the arguments from both sides only focused on the rational. They provided an academic discourse about the pros and cons of nuclear energy that would, in an ideal society, long precede far-reaching energy policy formulation.



Koeberg power station

It is however not 2005, but South Africa ten years thereafter, where a Finance Minister acknowledged as a good performer by all parties has just been fired because, according to most analysts, he had the temerity to point out that the Nuclear Build was economically unaffordable. Where construction on prestige mega-projects such as the giant new Medupi and Kusile coal power stations are stuttering along years behind schedule, at a cost that is now more than double the initial projection. Where tenders are allocated not according to price and technical quality, but to the politically best connected, and the employers and beneficiaries of decision makers' friends and families.

We as physicists must not allow ourselves to be blinded by the many dollar signs currently lighting up our horizon, and treat the numerous 'opportunities' linked to nuclear developments with extreme circumspection. The most critical issue right now is not the overall advantage or disadvantage of nuclear power, but the manner in which the proposed Nuclear Build is being forced on us. Let us not be the irresponsible generation of physicists that squealed with delight at the new toys and fun awaiting us, when this ends up bankrupting the country. ■

Obituaries

Prof Jan H van der Merwe, a renowned physicist passed away

By Prof Johan Malherbe and Prof Max Braun

It is with great sadness that we were informed that one of the most famous South African physicists, Prof Jan H van der Merwe (affectionately known as Prof Jan) passed away on Sunday 28 February 2016, on his 94th birthday.

Prof van der Merwe was born in Humpata, Angola from parents who were Dorslandtrekkers (literally translated Thirst land pioneers). In 1880 these Dorslandtrekkers passed through the Namibian desserts to settle in Angola. In 1928 they were relocated to Namibia (South-West Africa at the time), where Prof Jan attended school in various towns.

In 1941 he obtained a bursary to study Engineering at the University of Stellenbosch. After obtaining his BSc degree, he was persuaded by the Head of Applied Mathematics to change to an MSc in Applied Mathematics, which he obtained with distinction in 1945. In 1946 he was appointed as a junior lecturer in the Department of Applied Mathematics at the University of Stellenbosch. In 1947 he obtained a position at the CSIR (Council for Scientific and Industrial Research) in Pretoria under the supervision of Dr Meiring Naudé. The CSIR also awarded him a bursary to obtain a PhD in Britain. Just before leaving, he married Minnie (de Villiers) and they spent their honeymoon on the ship to the UK.

Dr Naudé arranged that he could pursue his PhD in Theoretical Solid State Physics under the leadership of Sir Neville Mott (a Nobel Laureate) at the University of Bristol. During this period Prof Jan befriended a number of very well-known physicists, such as another Nobel Laureate, Prof CF Powell, Professors Tyndall, Burton, Cabrera and Heinz and Doris Wilsdorf. Late 1949, Prof Jan returned to the CSIR, South Africa, in time for the birth of their first child Pauline (1950). Later, the family expanded, with Willem (1954), Jan (1957) and the adoption of Anna (1957). From 1953 to 1964 he served as a senior lecturer and thereafter Associate Professor in the Physics Department, University of Pretoria. He realised that he needed a better understanding of Mathematics. In 1956 he obtained an MSc in Mathematics at the University of Pretoria. During the period at the University of Pretoria, lectured MSc students of whom many well-known scientists (physicists and chemists) in South Africa. Many of them later attested to the enormous influence Prof Jan had on them. During this period he re-established friendship with another Bristol colleague, Prof Frank Nabarro, Head of Physics at the University of the Witwatersrand in Johannesburg. A sabbatical leave in 1961 at the University of Virginia with the Wilsdorfs enormously benefited his scientific outputs with many new seminal ideas, including enhancing his initial model to thickening two-dimensional interfaces in 1963.

After a personal invitation by his ex-CSIR colleague and at the time Rector, Prof Ernst Marais, of the newly established University of Port Elizabeth, Prof Jan was appointed as Head of the Department of Applied Mathematics in 1965. During this period at UPE and later on, Prof Jan was invited to present plenary talks at many international conferences. During these visits he made life-long friends with well-known surface scientists, such Ernst Bauer (Technical University of Claustal-Zellerfeld) and Ralf Vanselow (University of Wisconsin, Milwaukee). In 1969 he accepted a professorship in Applied Mathematics at Unisa (University of South Africa), a position which he occupied until 1967. In 1970 he spent a further eight months on sabbatical leave at the University of Virginia, where he collaborated with another life-long friend, Bill Jesser.

In 1972, Prof Jan accepted the position of Head of Department and Professor in Physics at the Department of Physics, University of Pretoria. With the establishment of the Foundation for Research Development (FRD) he was one of the first group of scientists to be rated, and received the highest rating possible (an A rating), which meant extra research funding attached to the prestige of the award. This enabled him to invite visiting scientists for an extended period, and Gary Shiflet of the University of Virginia became a friend and collaborator from that time onward. After his mandatory retirement at 65 years of age (the University of Pretoria was too late with a counter offer), Prof Jan took a Professor Extraordinarius position at the Physics Department, Unisa, from 1990 to 2003. From 2004 he was appointed as an Honorary Professor in the Department of Physics at the University of Pretoria. Apart from the two sabbaticals mentioned earlier (1961 and 1970) at the University of Virginia, Prof Jan also spent extended periods as Visiting Professor at the Technical University of Clausthal-Zellerfeld, Germany (1981 and 1989), University of Virginia, USA (1981) and Visiting Researcher to Kodak Research Labs, Richmond, USA.

Prof Jan suffered severe setbacks

later in his personal life, firstly with the death of his son, Jan, in 1994, his daughter, Pauline, in 1999, and finally his beloved wife, Minnie, in 2006. His elder son, Willem, and daughter-in-law, Marissa invited Prof Jan into their home and lovingly cared for him until he passed away on Sunday. Prof Jan greatly appreciated caring, love and affection of Willem, Marissa, his daughter, Anna and his grandchildren and great grandchildren.

The major part of Prof Jan's career was spent in publishing many seminal papers on the theory of epitaxy, resulting in him becoming known as the Father of Epitaxy. This field became extremely important in the 1960s and onwards, with the advances in the semiconductor industry. This field fundamentally depends on the growth of perfect single crystals for the manufacturing of transistors and IC circuits. His theory of epitaxy played an essential role in understanding how to achieve growing such perfect single crystals.

More fundamental in physics was his model of atomic forces and the energy minimisation concepts. This paved the way for successful modelling on an atomic scale of other important physical phenomena in solids. He personally regarded his solution to a differential equation in his PhD thesis as one of his biggest achievements. This was basically a soliton differential equation with an ingenious solution, the first ever analytical solution to a soliton problem. Solitons in solid state and other branches of physics are only now becoming important for advanced applications in communication technology.

Naturally for such a great scientist, he served on numerous important councils and committees, nationally and internationally. He received a large number of awards in recognition of his achievements, including the Havenga Prize for Physics (1967) from the Suid-Afikaanse Akademie vir Wetenskap en Kuns (South African Acade my for Science and Art), EW Muller Award (University of Wisconsin, Milwaukee, USA), FRD A rating first awarded in 1984 and re-awarded until the end of his working career, De Beers Gold Medal in Physics (1984), DSc (honoris causa) University of South Africa (1984), SAMES award for the best publication in the South African Journal of Physics (1987), the South Africa Order for Excellent Service, Class 1: Gold (1989), DSc (honoris causa) University of Pretoria (1990), DSc (honoris causa) University of Port Elizabeth (1994) and a Gold Medal of the South African Association for the Advancement of Science (1998). In 2000 a Symposium in honour of Prof JH van der Merwe on the 50th anniversary of his discovery of Interfacial Dislocations was arranged by the American Society for Metals, Materials and Minerals (2000). He achieved the Tuks Alumni Laureatus Award for Eminent Scientific Achievements (2000) and in 2008 he was awarded the Centenary Award, Leading Minds 1908 to 2008 by the University of Pretoria for his research.

His list of postgraduate student reads like the Who?s Who in Physics in South Africa, with his biggest legacy being the profound influence the manner of thinking and problem solving skills of his students. His students, colleagues, friends, family and Physics will remember him fondly, but will surely miss him ? a great son of South Africa. We express our deepest condolences to his family, numerous colleagues all over the world and his friends. In particular, we would like to extend our warmest sympathy to his son Willem and daughter-in-law, Marisa, his daughter Anna, his grandchildren and his great grandchildren.

Passing of a SA Physics legend Prof JS (Koos) Vermaak

André Venter HOD Physics NMMU,

This obituary is compiled from a document written and graciously supplied by Prof Pieter Wagner.

Prof JS (Koos) Vermaak, first HOD of the Department of Physics at the former University of Port Elizabeth (UPE), now the Nelson Mandela Metropolitan University (NMMU).

It is with great sadness that I inform you of the passing of the first HOD of the department of Physics at NMMU (formerly the University of Port Elizabeth, UPE), Prof J.S (Koos) Vermaak. Prof Vermaak was a pioneer in a number of fields within Physics and ended his career on a high note in research and development in the United States. He was also a provincial athlete and rugby player.

Koos Vermaak was born on 15 September 1936 on the farm Elandslaagte, district Middelburg, Transvaal. He received his primary schooling in a small two-teacher farm school in Elandslaagte, and later moved to boarding school in Bronkhorstspruit, where he completed his secondary school education at Erasmus High School in 1954. He matriculated with an A aggregate, with distinctions in mathematics, science, biology and wood & metalwork. Koos Vermaak was a talented allrounder who played provincial rugby for Northern Transvaal and also set numerous provincial records on the athletics track in the 880 yards and one mile events (he eventually became the SA u/19 champion in both of these).

He did not have funds for university study - no "Fees must fall" campaigns in those days - so he started his career as a miner in Carltonville. In 1955 he was awarded a merit study bursary by the Transvaal Education Department and subsequently enrolled simultaneously at Pretoria Normal Teaching College for a teaching diploma and also at the University of Pretoria (UP) for a BSc degree. During this period he displayed extraordinary dedication, studying at the College during the day and at the UP in the evening. He completed his BSc cum laude in 1957, majoring in physics, chemistry and mathematics. He also was a member of the College team that won the Northern Transvaal (NTvl) cross-country championship in 1957 and was elected to represent NTvl at the national championships. In that same year he was elected primarius of BenLo men's residence and vice-chairman of the Normal College student council.

In 1958 the Transvaal Agricultural Department offered him a bursary to study for a MSc degree in physics. He simultaneously enrolled for a MSc in mathematics at UP in 1958. In 1959 he completed his theoretical MSc courses and presented his dissertation Physical aspects of seed irradiation under Dr WR McMurray of the CSIR. In December 1958 he married his high school sweetheart, Susie de Winnaar, and also completed his MSc in mathematics. In 1960 he was appointed as an agricultural officer in the department of agriculture with his office in the faculty of agriculture at UP.

In 1962 he was offered a position as senior lecturer in physics at the then newly established Turfloop University College in Pietersburg. He joined Prof Danie Fourie at Turfloop to establish a physics department at the university. He registered in 1962 for a DSc in theoretical physics under Prof JH van der Merwe, famous for his contributions to the theory of epitaxy.

In December 1965 he was offered a senior lectureship in physics at the then newly-established university of Port Elizabeth (UPE). In 1967 Vermaak took unpaid study leave to further his studies and research under Prof Doris Kuhlman Wilsdorff at the University of Virginia, Charlottesville, USA. Both Doris and her husband, Hein, had good ties with the solid state scientific community in South Africa. They both studied with Prof Jan van der Merwe, at Bristol University. At this university, in 1949, the theoretical concept of misfit dislocations to describe the stress relief between two epitaxial grown bi-crystals was born in the thesis of Jan van der Merwe, about 12 years before it was first experimentally observed by John Mathews in 1961 (using an electronmicroscope, at Wits).

On his return to South Africa in 1968 he was appointed first full-time head and professor of the physics department at UPE. His first task was to build a strong research group in solid state physics. In 1971 he invited Dr Greg Olson, a PhD graduate student of Prof W Jesser of the University of Virginia to join his research group as a post-doctoral fellow. In 1974, on sabbatical leave, Vermaak joined Philips North America Research Laboratories as visiting senior scientist, where he was introduced to the world of semiconductor materials. On his return to Port Elizabeth in 1975 he introduced The growth and characterization of III-V, II-VI and Si epitaxial systems as the main research topic for the physics research group. In 1975 Dr George Proto, also a PhD graduate from the university of Virginia, joined his research group as a post-doctoral fellow. Together they were the first to introduce the technique of cross-sectional transmission electron microscopy to study defects in double hetero-junction degraded laser diodes. In 1982 he again joined

Phillips North America Research group as visiting scientist during his one year sabbatical. On his return in 1983, Vermaak and his research group received substantial research grants and contracts from industry, the CSIR, Armscor and the South African Institute for Microelectronics for their research efforts and training of graduate students in this field. They soon established a recognized Centre of Excellence in the field of compound semiconductor materials production and characterization in South Africa.

Vermaak was prodigiously active outside academia. Among others, he was president of the Eastern Province Rugby Union, served as a member of the South African Rugby Board (1976–1988) and also on the executive committee of the South African Rugby Board (1989-1991).

In 1993 Dr Vermaak was appointed director of laser development at Sensors Unlimited. In collaboration with Dr John Connolly and his laser group at Sarnoff Research Corporation, Sensors Unlimited commercialized 13 different wavelength DFB lasers that were mainly purchased by companies in the pollution monitoring business. In difficult beginning years this contributed to about a third of the total sales of the company. In 1998 Vermaak received an outstanding achievement award from Sensors Unlimited for his R&D efforts to increase the yield of the bump processing in the processing laboratory, from below 20% to over 80%.

Prof Vermaak retired at the end of 2002, living in St Francis Bay, where he played golf, fished, did woodwork and enjoyed his family of four married children and nine grandchildren.

Prof Koos was a gifted and colourful individual who made numerous contributions to society on various fronts. We honour his legacy. We extend our sincere condolences to his wife, Suzie and the family. ■

Prof JR "Bobby" Seretlo (1934-2016)

Manfred Hellberg, UKZN, Durban and Mmantsae Diale, University of Pretoria, Pretoria.

Jacob Robert "Bobby" Seretlo, the first Black South African to obtain a PhD in physics, passed away on 14th February 2016, after a distinguished career devoted to the development of science in general, and physics in particular, at the University of Fort Hare. Born in Villiers, Free State, in 1934, he was educated at Orlando High School, Soweto. After teaching in Soweto for a couple of years, he went to the University of Fort Hare (UFH), where he obtained a BSc (1959) and BSc (Hons) in Physics (1960). He met his wife, Elizabeth, at Fort Hare, where she was studying Chemistry. The marriage was blessed with four children, one of whom is an Associate Professor of Mathematics at North-West University, Thekiso Seretlo.

After his Honours degree, he was a research assistant at Witwatersrand University (Wits), where he did an MSc. However, as reported in the SAIP book "Physics in South Africa" (De Kock and Moraal, 2013), that was not plain sailing, for political reasons. Mrs Seretlo is quoted as having communicated the following: "My husband has an interesting history, for after completing his BSc Honours at Fort Hare, he and a colleague went on to Wits to register as MSc students, but because they were not allowed to, Prof Nabarro, who was Head of Physics at the time, arranged with Unisa that they should register there, while doing their research at Wits. My husband's supervisor was Prof Holt. Thus he qualified as MSc (Unisa). He then registered for a PhD with Unisa, but was supervised by Prof Wedepohl at Wits, who later moved to RAU. So, although his supervisor moved to RAU, he was still registered with Unisa. When they went to Wits the laws of the country did not allow for Black students to register at Wits, except for Medicine or Law." In view of this history, it is interesting to note that UNISA reported that his doctorate was the first PhD awarded by UNISA to a Black South African.

Seretlo's PhD was entitled "Reaction amongst point defects in alkali halide crystals". This research led to a paper with Wedepohl in J Phys C in 1968, followed by two single-author papers in 1972 in the journal Phys. Stat. Solidi. At Fort Hare he subsequently built up a research laboratory and supervised a number of postgraduate students, including his later successor, AM Mdebuka, with whom he published their work on thermoluminescence.

JR Seretlo devoted his working life to the University of Fort Hare. He joined the staff in 1964, quickly rose through the ranks, and in 1972 became the first Black South African to be appointed a Professor of Physics. In 1976 he became Head of Department, a position that he held until 1995, when Mdebuka took over from him. Seretlo played a massive role at UFH, being the Dean of Science from 1986 until his retirement in 1999, and also acting as a Vice-Rector. Naturally, he was an important player on Senate and other committees during some turbulent times. After his retirement, he continued to teach as a temporary lecturer until 2001 as there were staff shortages due to resignations. He was known at UFH as a bridge-builder in a divided society, who did not countenance racial prejudice and who took steps to ensure that the training and courses were of a high standard.

Prof Seretlo received numerous honours and awards during his career, starting with a City of Johannesburg bursary to study medicine. A CSIR research grant allowed him to spend time at the University of Wisconsin under the auspices of the US-SA Leadership Exchange Program (USSALEP). There he completed the coursework of the MS with distinction. In 1976 he was a Fulbright Fellow at Oak Ridge National Laboratory, Tennessee. His research there yielded his most widely cited paper, a Phys Rev B article on optical effects arising from radiation-produced defects, which he published with two co-authors. He also received a research grant to work at the Darmstadt Technical University in West Germany. Interestingly, he was featured in a 1980 book by Lee Nichols, Head of the Africa Division of the Voice of America, entitled “Science in Africa: Interviews with African Scientists”.

Apart from his research in solid state physics, his other big interest was physics education, where he concentrated particularly on the obstacles facing (predominantly rural) Africans of his era when entering science. His inaugural lecture, entitled “Some factors influencing the African’s attitude to science and his performance therein”, speaks to these problems and it was something he devoted much of his life to. It is noteworthy that this monograph, published by Fort Hare Press, is to be found in the libraries of a range of South Africa, European, American and Australian institutions. Another article, “Science in the African milieu”, in the SA Journal of Science, also deals with this question.

In view of this educational interest, it is no surprise that he played a prominent role in civic organisations associated with higher education. He was a member of the Ford Foundation black universities faculty fellowship program, Chairman of the regional selection committee of Fulbright Scholarship Program, and for many years a stalwart of the Board of the Education Opportunities Council, founded in 1977 by Archbishop Tutu, Dr Motlana and others, whose scholarship programme enabled disadvantaged leaders and potential leaders in South Africa to study in the USA. This wider interest is also reflected by his being one of seven distinguished South African scientists invited to attend a 1989 symposium in Paris, organised by the African Association for the Advancement of Science and Technology to explore ways of enhancing scientific cooperation in Africa.

Bob Seretlo served South African science more broadly in a number of ways. He was the first Black member of the SAIP Council, during the Presidency of Professor Fritz Hahne, in 1991-3. In1991 he was also appointed to the Council of the Foundation for Research Development (the science fore-runner of the NRF). Elected a Fellow of the Royal Society of South Africa in 1989, he was a member of its Council from 1995 to 1999. In 1996 he was elected a member of the Academy of Science of South Africa (ASSAf).

Internationally, Prof Seretlo also played a very important role, linked to his interest in physics education in Africa. One of two South African delegates to the IUPAP General Assembly in 1996, he was elected a member of Commission C14: Physics Education for two terms of office (1996-2002).

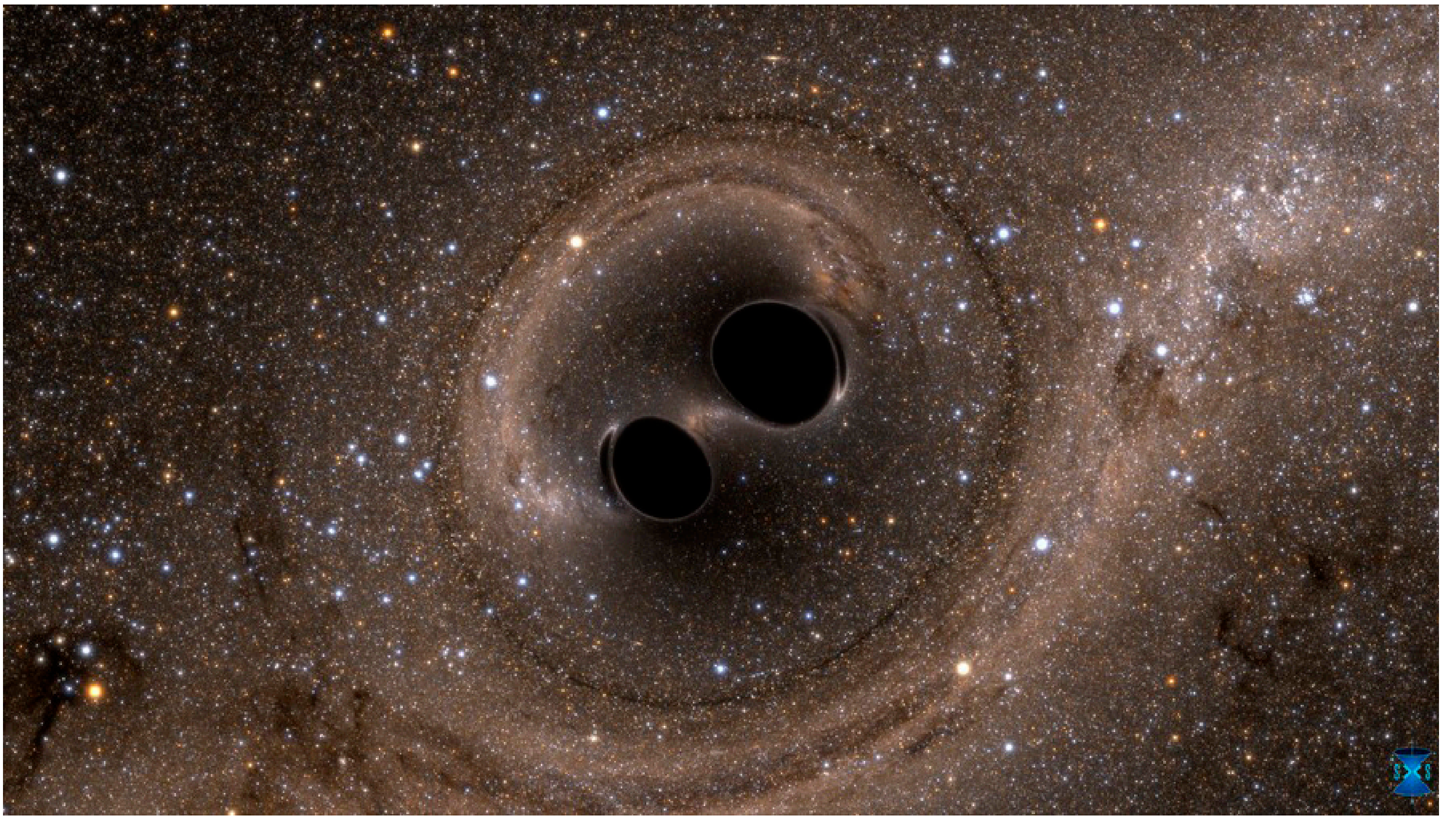
Seretlo’s MSc research gave him the opportunity to demonstrate to apartheid South Africa that science has no borders, when he presented his findings at an SAIP conference. Interviewed about racial segregation by Lee Nichols in 1980, he said that the scientific community of SAIP accepted him as a colleague in science – “we cooperate like fellow scientists, all of us worried about common concerns”. He is also quoted as saying, about the work of scientists “I believe that science transcends all barriers, be they racial, political; and I want to believe that scientists in whatever they are doing, for example whatever technology is developed, will in the final analysis benefit the whole of humanity.”

An icon to many, Professor JR (Bob) Seretlo was a pioneer who will be remembered for his wisdom and his passion for science, education and development, who did great things for many people in a difficult time in our history.

Gravitational Waves Detected 100 Years After Einstein's Prediction

LIGO Opens New Window on the Universe with Observation of Gravitational Waves from Colliding Black Holes

LIGO News Release. 11 February 2016



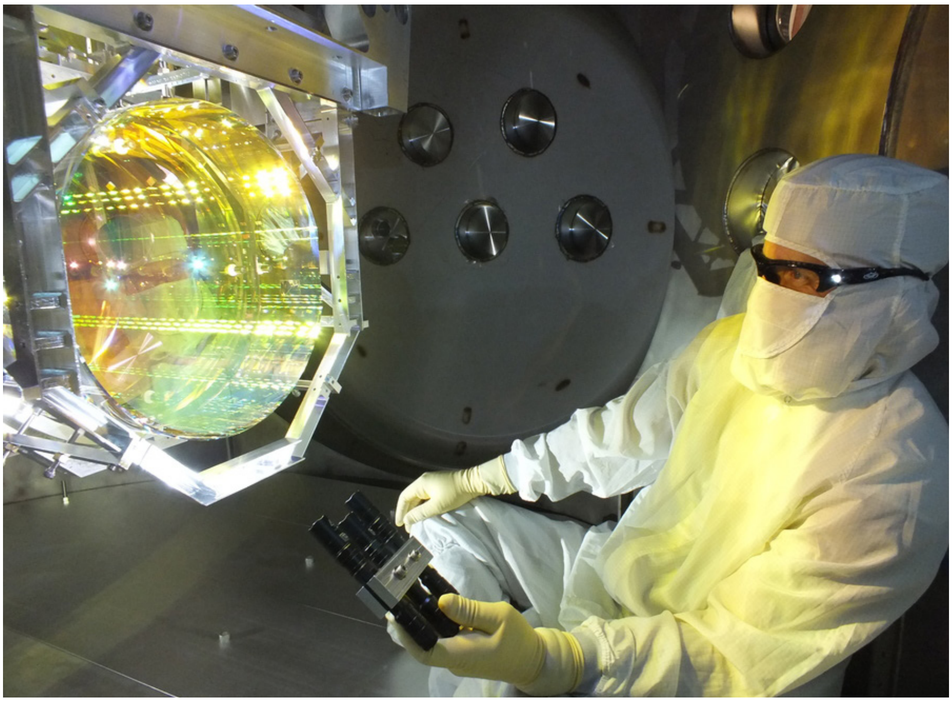
Two Black Holes Merge into One. The two merging black holes are each roughly 30 times the mass of the sun, with one slightly larger than the other. The event took place 1.3 billion years agoThe stars appear warped due to the incredibly strong gravity of the black holes. The black holes warp space and time, and this causes light from the stars to curve around the black holes in a process called gravitational lensing. The ring around the black holes, known as an Einstein ring, arises from the light of all the stars in a small region behind the holes, where gravitational lensing has smeared their images into a ring. The gravitational waves themselves would not be seen by a human near the black holes and so do not show in this video, with one important exception. The gravitational waves that are traveling outward toward the small region behind the black holes disturb that region's stellar images in the Einstein ring, causing them to slosh around, even long after the collision. The gravitational waves traveling in other directions cause weaker, and shorter-lived sloshing, everywhere outside the ring. Image Credit: SXS, the Simulating eXtreme Spacetimes (SXS) project (http://www.black-holes.org)

WASHINGTON, DC/Cascina, Italy

For the first time, scientists have observed ripples in the fabric of spacetime called gravitational waves, arriving at the earth from a cataclysmic event in the distant universe. This confirms a major prediction of Albert Einstein's 1915 general theory of relativity and opens an unprecedented new window onto the cosmos.

Gravitational waves carry information about their dramatic origins and about the nature of gravity that cannot otherwise be obtained. Physicists have concluded that the detected gravitational waves were produced during the final fraction of a second of the merger of two black holes to produce a single, more massive spinning black hole. This collision of two black holes had been predicted but never observed.

The gravitational waves were detected on September 14, 2015 at 5:51 a.m. Eastern Daylight Time (09:51 UTC) by both of the twin Laser Interferometer Gravitational-wave Observatory (LIGO) detectors, located in Livingston, Louisiana, and Hanford, Washington, USA. The LIGO Observatories are funded by the National Science Foundation (NSF), and were conceived, built, and are operated by Caltech and MIT. The



Inspecting LIGO's optics for contaminants. Prior to sealing up the chamber and pumping the vacuum system down, a LIGO optics technician inspects one of LIGO's core optics (mirrors) by illuminating its surface with light at a glancing angle. It is critical to LIGO's operation that there is no contamination on any of its optical surfaces.

discovery, accepted for publication in the journal Physical Review Letters, was made by the LIGO Scientific Collaboration (which includes the GEO Collaboration and the Australian Consortium for Interferometric Gravitational Astronomy) and the Virgo Collaboration using data from the two LIGO detectors.

Based on the observed signals, LIGO scientists estimate that the black holes for this event were about 29 and 36 times the mass of the sun, and the event took place 1.3 billion years ago. About 3 times the mass of the sun was converted into gravitational waves in a fraction of a second—with a peak power output about 50 times that of the whole visible universe. By looking at the time of arrival of the signals—the detector in Livingston recorded the event 7 milliseconds before the detector in Hanford—scientists can say that the source was located in the Southern Hemisphere.

According to general relativity, a pair of black holes orbiting around each other lose energy through the emission of gravitational waves, causing them to gradually approach each other over billions of years, and then much more quickly in the final minutes. During the final fraction of a second, the two black holes collide into each other at nearly one-half the speed of light and form a single more massive black hole, converting a portion of the combined black holes' mass to energy, according to Einstein's formula E=mc2. This energy is emitted as a final strong burst of gravitational waves. It is these gravitational waves that LIGO has observed.

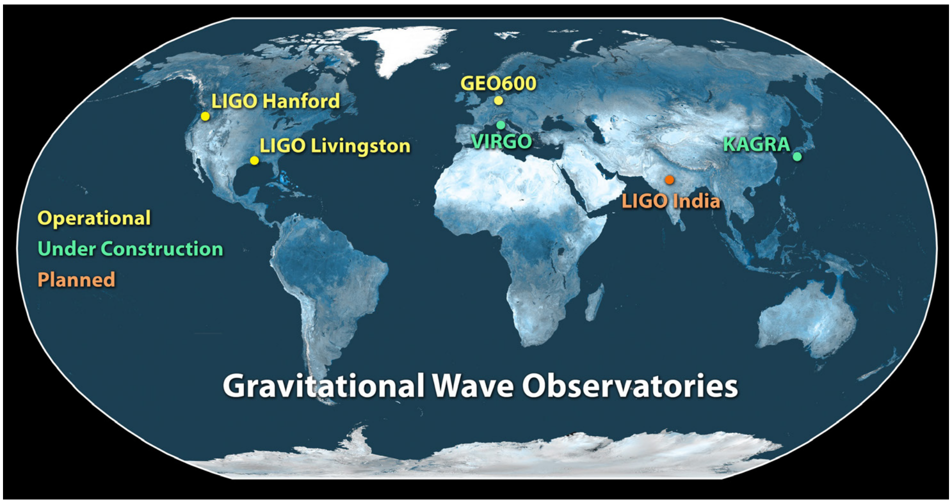
The existence of gravitational waves was first demonstrated in the 1970s and 80s by Joseph Taylor, Jr., and colleagues. Taylor and Russell Hulse discovered in 1974 a binary system composed of a pulsar in orbit around a neutron star. Taylor and Joel M. Weisberg in 1982 found that the orbit of the pulsar was slowly shrinking over time because of the release of energy in the form of gravitational waves. For discovering the pulsar and showing that it would make possible this particular gravitational wave measurement, Hulse and Taylor were awarded the Nobel Prize in Physics in 1993.

The new LIGO discovery is the first observation of gravitational waves themselves, made by measuring the tiny disturbances the waves make to space and time as they pass through the earth.

"Our observation of gravitational waves accomplishes an ambitious goal set out over 5 decades ago to directly detect this elusive phenomenon and better understand the universe, and, fittingly, fulfills Einstein's legacy on the 100th anniversary of his general theory of relativity," says Caltech's David H. Reitze, executive director of the LIGO Laboratory.

The discovery was made possible by the enhanced capabilities of Advanced LIGO, a major upgrade that increases the sensitivity of the instruments compared to the first generation LIGO detectors, enabling a large increase in the volume of the universe probed—and the discovery of gravitational waves during its first observation run. The US National Science Foundation leads in financial support for Advanced LIGO. Funding organizations in Germany (Max Planck Society), the U.K. (Science and Technology Facilities Council, STFC) and Australia (Australian Research Council) also have made significant commitments to the project. Several of the key technologies that made Advanced LIGO so much more sensitive have been developed and tested by the German UK GEO collaboration. Significant computer resources have been contributed by the AEI Hannover Atlas Cluster, the LIGO Laboratory, Syracuse University, and the University of Wisconsin- Milwaukee. Several universities designed, built, and tested key components for Advanced LIGO: The Australian National University, the University of Adelaide, the University of Florida, Stanford University, Columbia University of the City of New York, and Louisiana State University.

"In 1992, when LIGO's initial funding was approved, it represented the biggest investment the NSF had ever made," says France Córdova, NSF director. "It was a big risk. But the National Science Foundation is the agency that takes these kinds of risks.



Gravitational-Wave Observatories Across the Globe. Current operating facilities in the global network include the twin LIGO detectors—in Hanford, Washington, and Livingston, Louisiana—and GEO600 in Germany. The Virgo detector in Italy and the Kamioka Gravitational Wave Detector (KAGRA) in Japan are undergoing upgrades and are expected to begin operations in 2016 and 2018, respectively. A sixth observatory is being planned in India. Having more gravitational-wave observatories around the globe helps scientists pin down the locations and sources of gravitational waves coming from space. Image Credit: Caltech/MIT/LIGO Lab

We support fundamental science and engineering at a point in the road to discovery where that path is anything but clear. We fund trailblazers. It's why the U.S. continues to be a global leader in advancing knowledge."

LIGO research is carried out by the LIGO Scientific Collaboration (LSC), a group of more than 1000 scientists from universities around the United States and in 14 other countries. More than 90 universities and research institutes in the LSC develop detector technology and analyze data; approximately 250 students are strong contributing members of the collaboration. The LSC detector network includes the LIGO interferometers and the GEO600 detector. The GEO team includes scientists at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute, AEI), Leibniz Universität Hannover, along with partners at the University of Glasgow, Cardiff University, the University of Birmingham, other universities in the United Kingdom, and the University of the Balearic Islands in Spain.

"This detection is the beginning of a new era: The field of gravitational wave astronomy is now a reality," says Gabriela González, LSC spokesperson and professor of physics and astronomy at Louisiana State University.

LIGO was originally proposed as a means of detecting these gravitational waves in the 1980s by Rainer Weiss, professor of physics, emeritus, from MIT; Kip Thorne, Caltech's Richard P. Feynman Professor of Theoretical Physics, emeritus; and Ronald Drever, professor of physics, emeritus, also from Caltech.

"The description of this observation is beautifully described in the Einstein theory of general relativity formulated 100 years ago and comprises the first test of the theory in strong gravitation. It would have been wonderful to watch Einstein's face had we been able to tell him," says Weiss.

"With this discovery, we humans are embarking on a marvelous new quest: the quest to explore the warped side of the universe—objects and phenomena that are made from warped spacetime. Colliding black holes and gravitational waves are our first beautiful examples," says Thorne.

Virgo research is carried out by the Virgo Collaboration, consisting of more than 250 physicists and engineers belonging to 19 different European research groups: 6 from Centre National de la Recherche Scientifique (CNRS) in France; 8 from the Istituto Nazionale di Fisica Nucleare (INFN) in Italy; 2 in The Netherlands with Nikhef; the Wigner RCP in Hungary; the POLGRAW group in Poland; and the European Gravitational Observatory (EGO), the laboratory hosting the Virgo detector near Pisa in Italy.

Fulvio Ricci, Virgo Spokesperson, notes that, "This is a significant milestone for physics, but more importantly merely the start of many new and exciting astrophysical discoveries to come with LIGO and Virgo."

Bruce Allen, managing director of the Max Planck Institute for Gravitational Physics (Albert Einstein Institute), adds, "Einstein thought gravitational waves were too weak to detect, and didn't believe in black holes. But I don't think he'd have minded being wrong!"

"The Advanced LIGO detectors are a tour de force of science and technology, made possible by a truly exceptional international team of technicians, engineers, and scientists," says David Shoemaker of MIT, the project leader for Advanced LIGO. "We are very proud that we finished this NSF-funded project on time and on budget."

At each observatory, the two-and-a-half-mile (4-km) long L-shaped LIGO interferometer uses laser light split into two beams that travel back and forth down the arms (four-foot diameter tubes kept under a near-perfect vacuum). The beams are used to monitor the distance between mirrors precisely positioned at the ends of the arms. According to Einstein's theory, the distance between the mirrors will change by an infinitesimal amount when a gravitational wave passes by the detector. A change in the lengths of the arms smaller than one-ten-thousandth the diameter of a proton (10-19 meter) can be detected.

"To make this fantastic milestone possible took a global collaboration of scientists—laser and suspension technology developed for our GEO600 detector was used to help make Advanced LIGO the most sophisticated gravitational wave detector ever created," says Sheila Rowan, professor of physics and astronomy at the University of Glasgow.

Independent and widely separated observatories are necessary to determine the direction of the event causing the gravitational waves, and also to verify that the signals come from space and are not from some other local phenomenon.

Toward this end, the LIGO Laboratory is working closely with scientists in India at the Inter-University Centre for Astronomy and Astrophysics, the Raja Ramanna Centre for Advanced Technology, and the Institute for Plasma to establish a third Advanced LIGO detector on the Indian subcontinent. Awaiting approval by the government of India, it could be operational early in the next decade. The additional detector will greatly improve the ability of the global detector network to localize gravitational-wave sources.

“Hopefully this first observation will accelerate the construction of a global network of detectors to enable accurate source location in the era of multi-messenger astronomy,” says David McClelland, professor of physics and director of the Centre for Gravitational Physics at the Australian National University.

Additional video and image assets can be found here: http://mediaassets.caltech.edu/gwave

Caltech Kathy Svitil Director of News and Content Strategy. 626-676-7628 (cell); ksvitil@caltech.edu

MITKimberly AllenDirector of Media RelationsDeputy Director, MIT News Office. 617-253-2702 (office); 617-852-6094 (cell); allenkc@mit.edu

NSF Ivy Kupec Media Officer 703-292-8796 (Office);703-225-8216 (Cell); ikupec@nsf.gov

VirgoFulvio RicciRoma +39 06 49914261 (Office); Cascina +39 050 752 345 (Office); +39 348 3187354 (Cell); fulvio.ricci@roma1.infn.it

GEOSusanne Milde Phone: +49 331 583 93 55; Mobile: +49 172 3931349; milde@mildemarketing.de

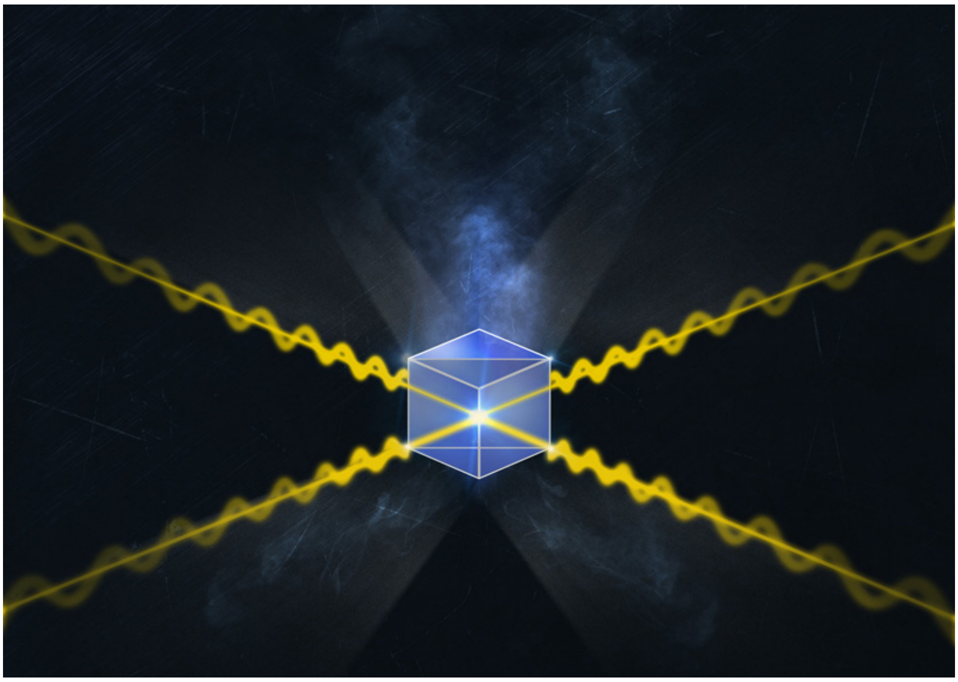
UK Science and Technology Facilities Council Terry O’Connor: +44 1793 442006; +44 77 68 00 61 84 (Cell); terry.o'connor@stfc.ac.uk

Max Planck Institute for Gravitational Physics Hannover Benjamin Knispel Press Officer: +49 511 762 19104; benjamin.knispel@aei.mpg.de

First demonstration of quantum interference in high dimensions

Researchers in South Africa and Scotland have demonstrated a new approach to quantum state engineering that requires only a beamsplitter.

Prof Andrew forbes, Wits, Johannesburg.



Einstein described the quantum world’s behaviour as that “spooky action at a distance”, seemingly counter-intuitive and breaking the rules of what we might expect. The latter is connected to a quintessential property of the quantum world known as entanglement, where a measurement on a particle affects what is measured somewhere else on a different particle. But what happens when particles of light (photons) are brought together onto a partially reflecting mirror (beamsplitter) that is designed to send half the light one way and half the other way? When there is lots of light it splits 50/50, as we might expect. But when two single photons are incident on the mirror they strangely “misbehave”: they either BOTH go one way or BOTH the other way, they never split in the beamsplitter. Now a team comprising researchers from the CSIR, UKZN, Heriot-Watt University (Scotland) and the U. Witwatersrand have shown that it is possible to make the photons pass through the beamsplitter in different directions by having an entangled state as the input. When the state is symmetric, the “one way” behavior is observed -- they misbehave. But when the input state

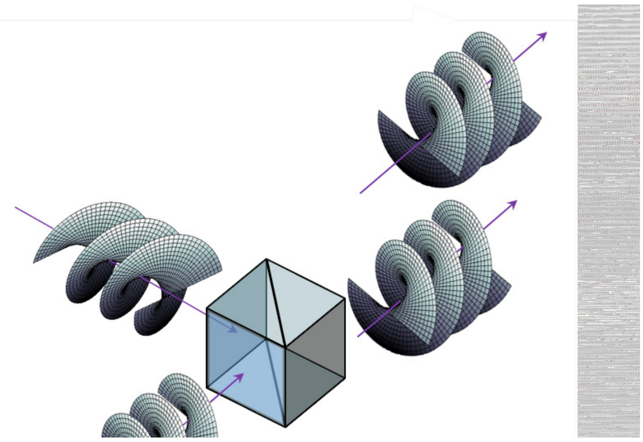


Figure 1: Artist's impression of the quantum interference at the beamsplitter with twisted. Credit: Marko Mandusic. Copyright: University of the Witwatersrand.

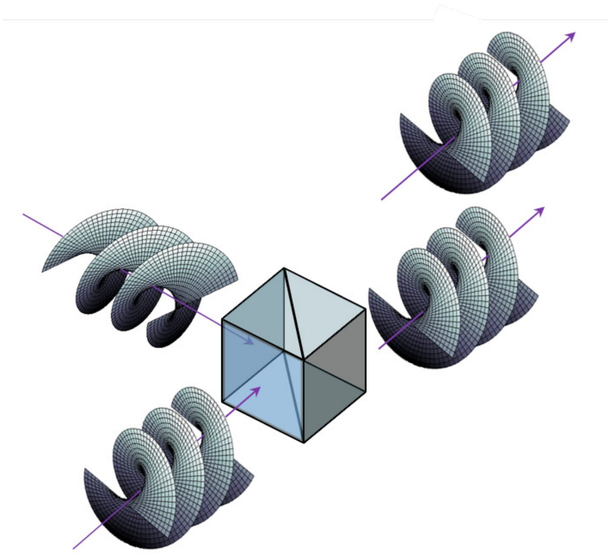


Figure 2: In a two photon experiment, when the photons are the same, they either both go one way or both the

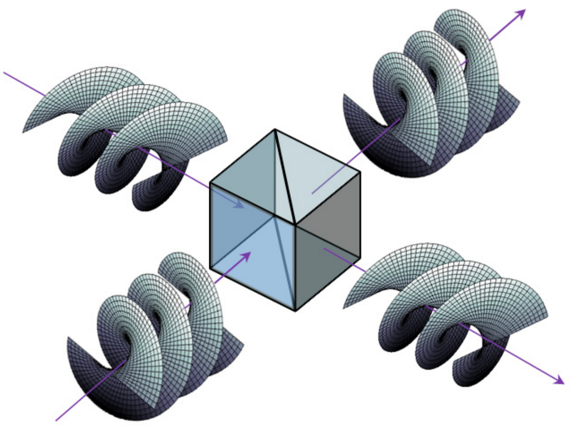


Figure 3: When the input is an entangled state that is antisymmetric, the output has photons in both ports. OAM carrying light has a twisted wavefront and can be entangled in high dimensions, so using this type of entanglement on the beamsplitter one can prepare high-dimensional entangled states at the output.

is antisymmetric, the photons take opposite paths.. Moreover, the international team could use this simple beamsplitter – nothing more than a cube of glass – to engineer a six dimensional quantum state using twisted light carrying orbital angular momentum. This work, published in SCIENCE ADVANCES, the online journal of SCIENCE, paves the way to practical tools for exploiting entangled light, such as quantum communication and teleportation.

The collaboration has a joint project funded by the Photonics Initiative of South Africa (PISA) to demonstrate real-world quantum communication; with the present work a step towards this goal. Project leader Prof. Andrew Forbes of the U. Witwatersrand: "Our project aims to bring quantum technologies out of the laboratory and into the real-world, to demonstrate a secure link using quantum encryption." Anyone who knows the story of the Enigma machine knows that encryption based on human ingenuity is flawed – it is always possible that your adversary is smarter than you. But quantum encryption is based on the very laws of Nature, and so fundamentally secure. The challenge is to make this work in high dimensions and in the real world. In this recent advance, the team have used so-called "twisted" light, light that carries orbital angular momentum, to reach dimensions beyond the usual two. High-dimensional quantum entanglement is a tricky business. A single quantum measurement with a high-dimensional quantum state can take the entire weekend to perform, running 24 hours a day. But the advantage of high-dimensions is that more information can be packed into the light, increasing the rate of data transfer. According to Dr Roux, team leader at the CSIR laboratories, "We want to use this technology to demonstrate secure quantum communication over a long distance. We are working on several approaches to achieve this, some theoretical and some experimental." The next step in the project is to demonstrate that it is possible to teleport quantum states in high dimensions. "Teleportation offers a means to cover potentially large distances with entangled states, but has never been done in more than two dimensions," says Prof.Konrad, who conceived of the idea on how to teleport high dimensional states.

Team Members:

The experimental work was performed at the CSIR laboratories and will be followed up with experiments at the Heriot-Watt laboratories in Scotland. Dr Yingwen Zhang, a post doctoral fellow at the CSIR, performed the key experiments. Prof. Andrew Forbes and Prof. Stef Roux have positions at both the CSIR and the U.Witwatersrand, Prof. Thomas Konrad is with UKZN and Dr Jonathan Leach and Ms Megan Agnew are with Heriot-Watt U. in Edinburgh, Scotland.

For further information contact the corresponding author, Prof. Andrew Forbes Andrew.forbes@wits.ac.za or +27 82 823 1836.

University of the Free State installs tuneable laser based fluorescence spectrometer for nanophosphor research

Ted Kroon, Hendrik Swart and Martin Ntwaeaborwa

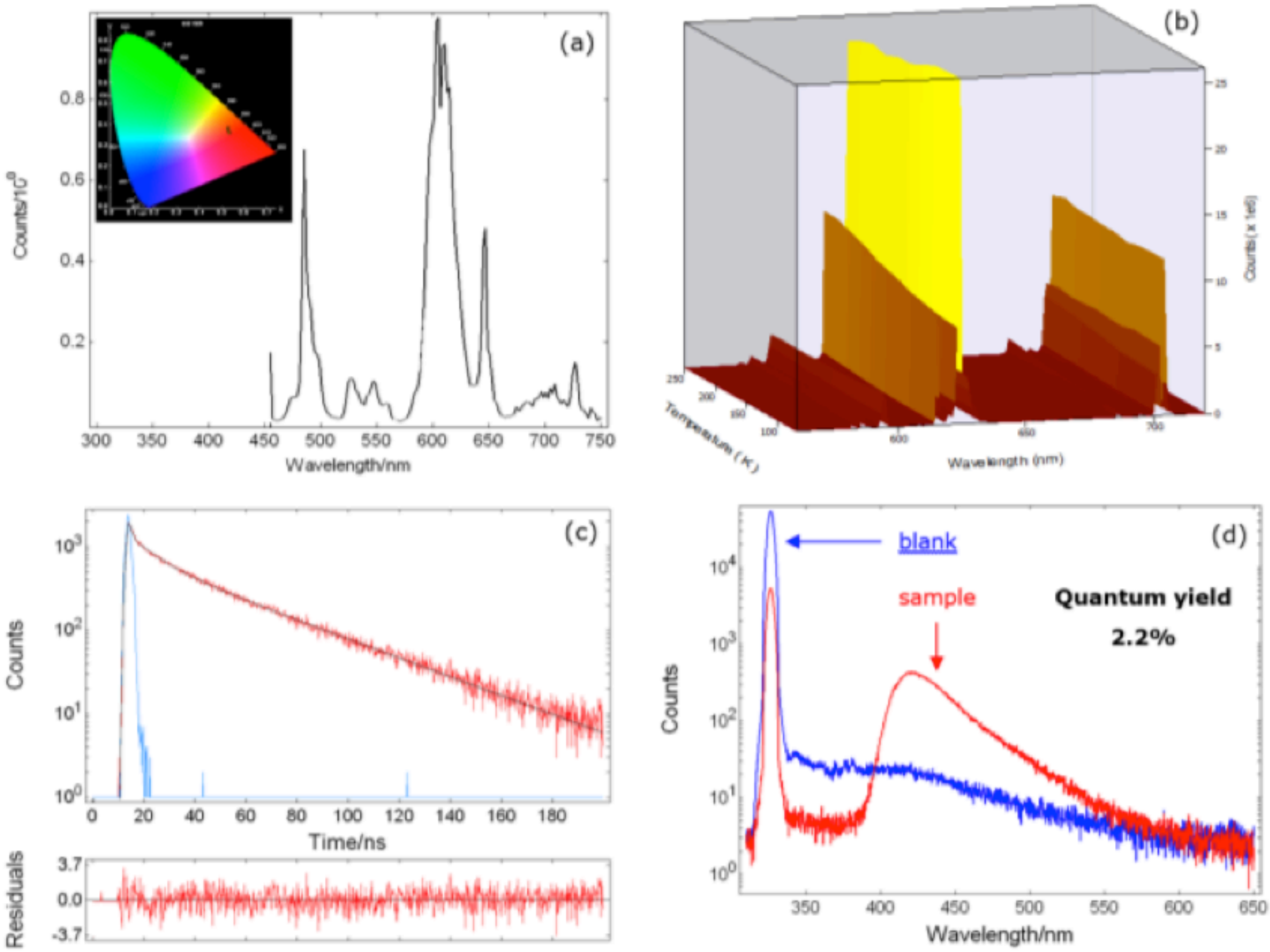
United Nations Educational, Scientific and Cultural Organization

International Year of Light 2015

Leading international research requires continuous upgrades of equipment to remain competitive. Installation of a multimillion rand fluorescence spectrophotometer acquired from the leading photonics equipment manufacturer Edinburgh Instruments (represented locally by Hitech Lasers) during October 2015 was a further step along this path for the Department of Physics and its mission towards producing well-rounded graduates and excellent research. Funding was obtained through a grant of the National Nanotechnology Equipment Programme of the National Research Foundation as well as the University of the Free State. The new equipment complements other world-class facilities acquired by the Department of Physics over the past decade, such as X-ray photoelectron spectroscopy, scanning Auger spectroscopy, scanning electron microscopy with cathodoluminescence spectroscopy, and secondary ion mass spectrometry, and it places the optical characterization of luminescent materials at the same level. The acquisition of the equipment during the United Nations International Year of Light is especially fitting, and the equipment has been installed in the recently expanded wing of the Physics department.

The fluorescence measurement of phosphors presents some specific challenges, in particular the high scattering of light from powder samples which often interferes with the measurement. The new FLS980 spectrometer is equipped with double monochromators to minimize this stray light. Fluorescence applications range from the deep ultraviolet to the near infrared, requiring a number of excitation sources and photon detectors for the system and all-mirror optics to maintain focussing. Besides conventional continuous and pulsed xenon lamps, a nanosecond flashlamp, high repetition rate ultraviolet LEDs and a powerful 980 nm infrared laser for upconversion studies, the most 'exciting' excitation source is a tuneable laser based on a frequency tripled Nd-YAG laser from Continuum driving their Horizon 'OPO' or optical parametric oscillator, the output from which can be tuned in a range exceeding 200-2000 nm.

Staff and postgraduate students pay careful attention as the operation of the new instrument is explained



Some test measurements performed during installation: (a) Corrected CIE chromaticity analysis of Pr3+ doped NaCaPO4 emitting red light; (b) Temperature dependence of different Eu3+ emission peaks from a La2O2S phosphor; (c) Decay curve of Ce3+ emission in SrF2 (ns range); (d) Quantum yield analysis of SrF2:Eu2+,Yb3+.

The new spectrometer has full correction for the spectral response of its light sources, the optics (i.e. diffraction gratings) and detectors so that accurate assessments of the perceived colour can be plotted on CIE diagrams, which is vital for assessing phosphors for display and white-LED applications. It is equipped with an integrating sphere for direct measurements of absolute quantum yields from the phosphor powders, as well as a liquid helium cryostat for temperature-dependent measurements down to 4K. In addition to a CCD camera, the system has three photomultiplier detectors operating with photon counting electronics, one of which is dedicated to infrared measurements and another to fast lifetimes down to ~1 ns. The measurement of how fast excited optically active centres emit their energy (photon) is of great interest to Prof Ted Kroon, because its represents an additional dimension to the information from light emitting samples beyond their brightness and colour, and is particularly important for the study of energy transfer between different centres e.g. in co-doped samples containing a variety of rare-earth ions. Such energy transfer processes are of fundamental importance for our understanding of materials as well as of great practical value for engineering desired optical properties such as absorption and emission bands.

The Physics Department welcomes requests from anyone wishing to use the facilities as part of its collaborations with local and international universities and research institutions, while Hitech Lasers has provided a demonstration fluorescence spectrometer facility for any interested parties at the Physics Department of the University of the Free State.

Author Biography: The authors are part of the phosphor research group at the University of the Free State (www.ufs.ac.za/physics). An overview of recent research from this group can be obtained by consulting the Proceedings of the Sixth South African Conference on Photonic Materials (http://www.sciencedirect.com/science/journal/09214526/480).

Jobs and study opportunities

Post Docs at NWU Space Research

The Centre for Excellence in Space Research (CSR) at the North-West University in Potchefstroom, South Africa announces three postdoctoral research fellowships, one in each of the following areas:

1. Heliospheric Physics (with focus on computational modeling)
2. Turbulence studies
3. High-mass star formation and masers

For more details visit: http://saip.org.za/index.php/careers1/job-ads/350-post-docs-at-nwu-space-research

Upcoming conferences and workshops

2016 International Pulsar Timing Array (IPTA) conference

The 2016 International Pulsar Timing Array (IPTA) conference will be held in Stellenbosch in June 2016.

The conference consists of two parts:

1. The IPTA2016 student week (20-24 June 2016)
2. The IPTA2016 science week (27 June - 1 July 2016)

The International Pulsar Timing Array (IPTA) is a consortium of pulsar timing groups worldwide who pool their expertise and resources with the aim of detecting gravitational waves (GW) through the long term monitoring of several millisecond pulsars.

The student workshop will include a number of lectures and hands on activities that aim to familiarize participants with the various tools used in detecting gravitational waves from pulsar observations. The IPTA's annual science meeting this year will feature an expanded scope, covering more areas of pulsar science than in previous years. It will also coincide with the 2nd international pulsar workshop in South Africa.

The SKA South Africa project office has provided support to cover accommodation (at the university residences) and registration fees for 50 students during the workshop and science meeting. Additionally, a limited number of travel grants are available for South African students. Registration costs for the science meeting have not yet been finalized but an upper limit of R4000 (~$250US) is expected.

The student week is aimed at postgraduate students at MSc level and beyond, with an interest in pulsar science and with a background in physics, astronomy, mathematics or engineering.

See the IPTA2016 web site for details of topics covered during the student and science week: http://ipta.phys.wvu.edu/

Pre-registration for the IPTA2016 student week and IPTA2016 science week is now open.

On behalf of the organising committees of IPTA2016, we look forward to seeing you in Stellenbosch.

Patrick Woudt.
Chair LOC IPTA2016

QuEBS

2-3/6-9 June 2016

Durban

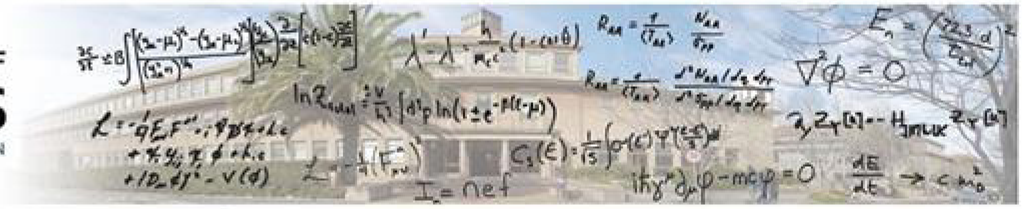
Quantum Effects in Biological Systems

-Call for Submissions-

School: 2-3 June 2016
Conference: 6-9 June 2016
Location: Protea Hotel Edward, Durban, South Africa

Submission of abstracts	18 March 2016
Confirmation of acceptance	4 April 2016
Latest registration	30 April 2016

DEPARTMENT OF PHYSICS
UNIVERSITY OF CAPE TOWN



SOUTH AFRICAN INSTITUTE OF PHYSICS

DEPARTMENT OF ASTRONOMY
UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

South African Institute of Physics

61st Annual Conference
University of Cape Town
4 - 8 July 2016

Call for Abstracts

The Department of Physics and the Department of Astronomy of the University of Cape Town will jointly host SAIP2016.

The conference will run from 5-8 July 2016 and will be preceded on 4 July by a Winter School on the theme “Physics of the Early and the Late Universe”.

Please note the following schedule:

Registration opens:	1 Feb 2016
Abstract Submission opens:	1 Feb 2016
Abstract submission deadline:	11 April 2016
Notification of acceptance of abstracts:	6 May 2016
Early Bird Registration closes:	13 May 2016
Booking and payment of accommodation closes:	10 June 2016
Registration closes:	10 June 2016

All participants are kindly requested to keep to the schedule as indicated.
For all details please see the website at http://events.saip.org.za/event/saip2016.

CONFERENCE PROCEEDINGS

The procedure of the SAIP 2016 conference will be peer reviewed and produced in accordance with the DHET guidelines for recognition at the level of 0.5 units per article. Only papers that are submitted strictly on or before 23:59SAT on 4 July 2016 will be considered for publication. The guidelines for authors, the application procedure for recognition of your article and the other details relating to the procedure will be available on the conference website.

SAIP2016 Abstracts Submission Now Open

For more details http://events.saip.org.za/conferenceCFA.py?confId=86

CCP2016 Abstracts Submission Now Open

More Details at http://events.saip.org.za/event/ccp2016

Physics Comment Editorial Policy

Deadline for submissions for the June 2016 issue of Physics Comment is 31 May 2016

Physics Comment is an electronic magazine for the Physics community of South Africa, providing objective coverage of the activities of people and associations active in the physics arena. It also covers physics-related ideas, issues, developments and controversies, serving as a forum for discussion. It is not a peer review journal.

Physics Comment publishes innovative reports, features, news, reviews, and other material, which explore and promote the many facets of physics. Physics Comment endeavours to:

- support and inform the physics community
- promote membership of the South African Institute of Physics
- promote the understanding of physics to interested parties and the general public
- represent the readers' point of view
- focus on issues and topics of importance and of interest to the physics community

We accept submissions on any physics-related subject, which endeavours to inform readers and to encourage writers in their own researches. We aim to be politically, socially and geographically inclusive in the articles, which we commission and receive. Therefore we shall not discriminate according to political or religious views. Physics Comment does not support or endorse any individual politician or political party. However, contributions, which are being published, may contain personal opinions of the authors.

It is our desire to present unfettered the opinions and research of our readers and contributors. All articles submitted for publication are subject to editorial revision. Such revisions, if necessary, will be made in cooperation with the author.
The views expressed in published articles are those of the authors and are not attributed to the Editorial
The Editor will make the final determination of the suitability of the articles for publication.

Declaration by Author

When an author submits material for publication, this means:

- The author(s) assures the material is original, his/her own work and is not under any legal restriction for publication online (e.g., previous copyright ownership).
- The author allows PC to edit the work for clarity, presentation, including making appropriate hypermedia links within the work.
- The author gives PC permission to publish the work and make it accessible in the Magazine's archives indefinitely after publication.
- The author may retain all other rights by requesting a copyright statement be placed on the work.

Authors should respect intellectual integrity by accrediting the author of any published work, which is being quoted.

Publication Deadlines

Physics Comment is published four times a year.

Issue	Closing Date	Publication Date
Issue 1	28 February	15 March
Issue 2	31 May	15 June
Issue 3	31 August	15 September
Issue 4	30 November	15 December

Specification and Submission of Content

Editorial Tone. As the voice of the physics community, the magazine will create a provocative, stimulating, and thoughtful dialogue with the readers; and provide a variety of perspectives that reflects the dynamism of the physics community.
Article types. The magazine is devoted to articles, reports, interesting facts, announcements and recent developments in several areas related to physics:
Manuscripts. Solicited manuscripts will be judged first for reader interest, accuracy and writing quality. The editor reserves the right to request rewrite, reject, and/or edit for length, organization, sense, grammar, and punctuation.
Re-use. The publisher reserves the right to reuse the printed piece in full or in part in other publications.
Submission and Format. Manuscripts must be submitted to the editor on or before the designated due date Manuscripts must be submitted electronically, on the prescribed Microsoft Word template available for download from http://www.saip.org.za/PhysicsComment/. Manuscripts are to be submitted directly to the editor: PhysicsComment@saip.org.za.
Style. AP style is followed for punctuation, capitalization, italics and quotations.
Photography and Illustration. All solicited photography and illustration should be part of an article and will be judged first for technical quality and editorial appropriateness.
The editor and art director reserve the right to request revision or reject any material that does not meet their criteria. The publisher reserves full rights to all solicited photography and illustration, including the right to reprint or reuse graphic material in other publications.

Categories of Content Contributions

Technical articles and reports: These are generic articles of about 1 500 words plus diagrams and pictures. A technical article covers a relevant feature topic. Articles are authored by the writer and publishing a 40-word resume of the author could enhance its credibility. By submitting an article that has been previously published the author confirms that he/she has the right to do so, and that all the necessary permissions have been received. Acknowledgement must be made within the article.
News: These are short editorial items usually not more than 250 words. Full colour pictures must be clearly referenced on the editorial submission and on the picture or picture file.
Advertorials: Advertorials could be published when supplied by the client. We recommend a maximum of 500 words plus one or two pictures for maximum impact. A PDF file of the laid out advertorial should be emailed by the client along with an MS Word file of the text and separate image files of the pictures. It is the client's responsibility to ensure that the advertorial is correct as it is in fact a paid for advert page.
Letters to the Editor: Letters to the Editor are encouraged. The Editor reserves the right to edit for length and format. The Editor will not change the political position of the initial letter. Physics Comment does not publish anonymous letters.
Advertising Policy: The Editorial Board will determine advertising prices for Physics Comment, subject to approval by SAIP Council. The objective will be to obtain revenue to maintain and develop the magazine. Physics Comment offers classified advertising to subscribers of the magazine for free. The advertisements must be a maximum of 60 words including the telephone number, and there is a limit of three free classifieds per subscriber, per issue. Advertisements may include a photo, which may be reduced in size or resolution by the editor to optimize loading time. All items or opportunities, which are being advertised for free, should be physics-related.
The Editor reserves the right to refuse any advertising, which does not conform to the objectives of the magazine.

Submission of Articles

All articles must be submitted on the prescribed template available for download from http://www.saip.org.za/PhysicsComment/ Physics Comment